Iowa Department of Natural Resources
Environmental Protection Commission

ITEM **7** **DECISION**

TOPIC **Contract – United States Geological Survey – Stream Flow Estimation**

The Department requests Commission approval of a $46,750 contract with the United States Geological Survey to begin a program to estimate stream flow at ungaged sites.

The purpose of this Agreement is to develop a method for estimating flow on ungaged streams and evaluating the potential application of an empirical surface-water quality model for understanding the differences in fate of nutrients between watersheds in Iowa. This contract begins the development of a program to develop flow estimates at ungaged sites in Iowa. Lack of streamflow information is a problem for a variety of DNR programs including the ambient monitoring program, NPDES, TMDL, Fisheries, among others. Adding new gages is cost prohibitive and unlikely to provide information in small watersheds. This project seeks to overcome this problem by developing statistical estimation techniques that will allow a user to define a point on the landscape and derive daily mean streamflow. This contract covers the period from July 3, 2007 through September 30, 2007 and provides funding for the USGS to identify potential statistical techniques for testing and evaluation.

Funding for this contract comes from Environment First – Infrastructure Funds.

Mary Skopec
Section Supervisor
Water Monitoring and Assessment
Iowa Geological Survey and Land Quality Bureau
Environmental Services Division

June 10, 2007

Budget

Party	Amount of Contribution
USGS	$79,072.00
DNR	$46,750 ($40,821 In-Kind for services)
Total	$166,643.00

Appendix A: Program to design method for estimating stream flow and water quality

Program objective is to design a method for providing an estimate of stream flow and stream water quality at any given geographic point on stream in Iowa for current and theoretical hydrologic and watershed conditions.

The development and verification of predictive tools and models is an essential step in understanding and successfully managing U.S. waters in the future. Such tools are needed to extrapolate or forecast conditions to unmonitored, yet comparable areas, both in space and in time. In light of increasingly diminishing resources, we simply cannot expect to monitor our water resources directly in all places and at all times. We therefore must get smarter, enhancing the value of data collected at individual sites, and applying our understanding of the hydrologic system and water-quality conditions to broader areas, including entire stream reaches and aquifers, large river basins, ecoregions, states, and even the nation. Moving from monitoring to modeling ultimately gives us state-wide, regional, and even national assessments of water quality.

The development of predictive tools helps to prioritize contaminant sources and to tease out the importance of factors affecting water quality, including landscape features and hydrologic transport. These predictive tools can help estimate conditions that often cannot be directly measured, such as the effects of specific management practices or the percentage of contamination in a stream that originates from different sources.

The approach will be a multi-phase development of a system of estimation programs at the HUC 12 scale. The initial construction of the program will be based upon the STREAMSTATS program for which high and low flow estimations are being developed for Iowa stream. The possible progression steps for utilizing STREAMSTATS are as follows:

a) High flow (2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year occurrence intervals)
b) Low-flow (one day and seven day periods for 5 and 10 year occurrence intervals)
c) Mean daily flow for current hydrologic and watershed conditions; equations need to include dynamic parameters that are subject to current conditions such as precipitation and paired watershed with real-time measured stream flow
d) Mean daily flow for theoretical hydrologic and watershed conditions; equations need to include dynamic parameters that are subject to change such parameters as precipitation, pervious area, tile drainage, percent row crop, and retention area
e) High and low flow estimation for theoretical hydrologic and watershed conditions; equations need to include dynamic parameters that are subject to change such parameters as precipitation, pervious area, tile drainage, percent row crop, and retention area

The ability to estimate stream flow is dependent on statistically robust data. The statistical analysis for estimation within a minimum error requires a designed data collection of stream flow based upon physiographic and watershed characteristics. The regression equations for high and low flow will likely be completed through a regionalization of the watershed and be separated into small and large watersheds; the analysis will be dependent on having a sufficient range of collection points within each region.

Water quality estimation process has to start simple with average load calculations of a few constituents. From there the process could progress to more complicated estimations for estimation of concentrations over a hydrograph, additional constituents, simulation of how loads may be changed if hydrologic or watershed characteristics are altered. Etc. A proposed sequence of steps in estimating surface water quality could be the following:

a) Review and analyze water quality information already collected
b) Develop preliminary estimation methods for sediment(turbidity?), nitrogen, and phosphorus
c) Determine the distribution of sites and watersheds to optimize the estimation/minimize error
d) Optimize a water quality collection network for estimating constituents
e) Determine the location, extent (point versus continuous) of sampling, and constituent sampled
f) Analyze the relation between physical and chemical determinations and biological habitat
g) Determine what biological sampling aspects could mimic cumulative water quality impacts

h) Expand estimation methods for additional constituents; determine effectiveness of models

The SPARROW (SPAtially Referenced Regressions On Watershed Attributes) model has been used to for national and regional assessment of water quality of stream in relationship to land use and watershed characteristics. SPARROW relates in-stream water-quality measurements to spatially referenced characteristics of watersheds, including contaminant sources and factors influencing terrestrial and stream transport. The model empirically estimates the origin and fate of contaminants in streams, and quantifies uncertainties in these estimates based on model coefficient error and unexplained variability in the observed data. Iowa is the focal point for land use change to predominately corn production in response to the projected increase in ethanol manufacturing. Resource managers in Iowa need a simulation tool for understanding the potential impacts of the rapid land use change on the water quality of streams.

The scope of the pilot study is to evaluate the utility of the SPARROW model on simulation of land use changes in Iowa on stream water-quality. The model would be a state-wide application using the framework of the current national-scale model. Specific objectives are:

1) To obtain the SPARROW model framework and port the model for a state-wide application;

2) To develop and successfully execute the SPARROW model for Iowa using the national scale information;

3) To update the model input data with current information on a smaller scale for Iowa; the Iowa Department of Natural Resources in-kind services contribution to the project is obtaining, formatting, and providing the updated information on a variety of input data such as land use, crop production, fertilizer application, conservation reserve program acreage, etc.;

4) To execute the SPARROW model using the updated information to simulate expected impacts on stream water quality; and

To verify the SPARROW model simulation in comparisons with stream water-quality data from the state ambient surface water-quality program.

The evaluation of the SPARROW model for simulating the impacts of changing land use on stream water quality will be presented at the Iowa Water Monitoring Conference in 2008. If the pilot study indicates that the SPARROW model can be used successfully in Iowa for the simulation of changing agricultural practices on stream water quality then a project proposal will be developed. If developed, the full-scale project will include implementation of SPARROW for both state-wide as well as individual watershed model applications to address current and anticipated watershed conditions.